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(54) **AC/DC MAGNETIC DRILL PRESS**

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B23B 45/14 (2006.01)

(52) **U.S. Cl.** **408/76**; 408/124

(58) **Field of Classification Search** 408/76, 408/124; 318/139, 400.3, 400.38; 388/937; 200/522, 43.17; 173/217
See application file for complete search history.

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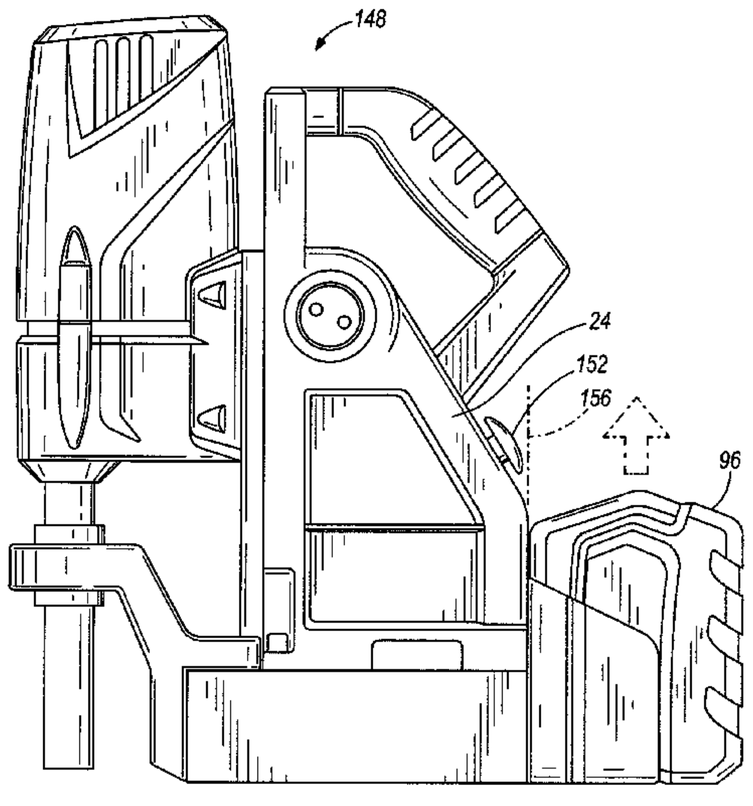
(57) **ABSTRACT**

A drill press includes a housing and a motor assembly, with a motor carriage attached to the housing. The motor assembly includes an electric motor and drill bit, and the motor carriage is operable for moving the motor assembly relative to the housing. A base, coupled to a portion of the housing, is operable for magnetically coupling the tool to a workpiece. The drill press also includes a DC power source and an AC power input for providing power to the motor. A power supply switching unit, electrically coupled to DC power source and the AC power input, selectively electrically couples the motor with one of the DC power source and the AC power input for providing power to the motor.

20 Claims, 12 Drawing Sheets



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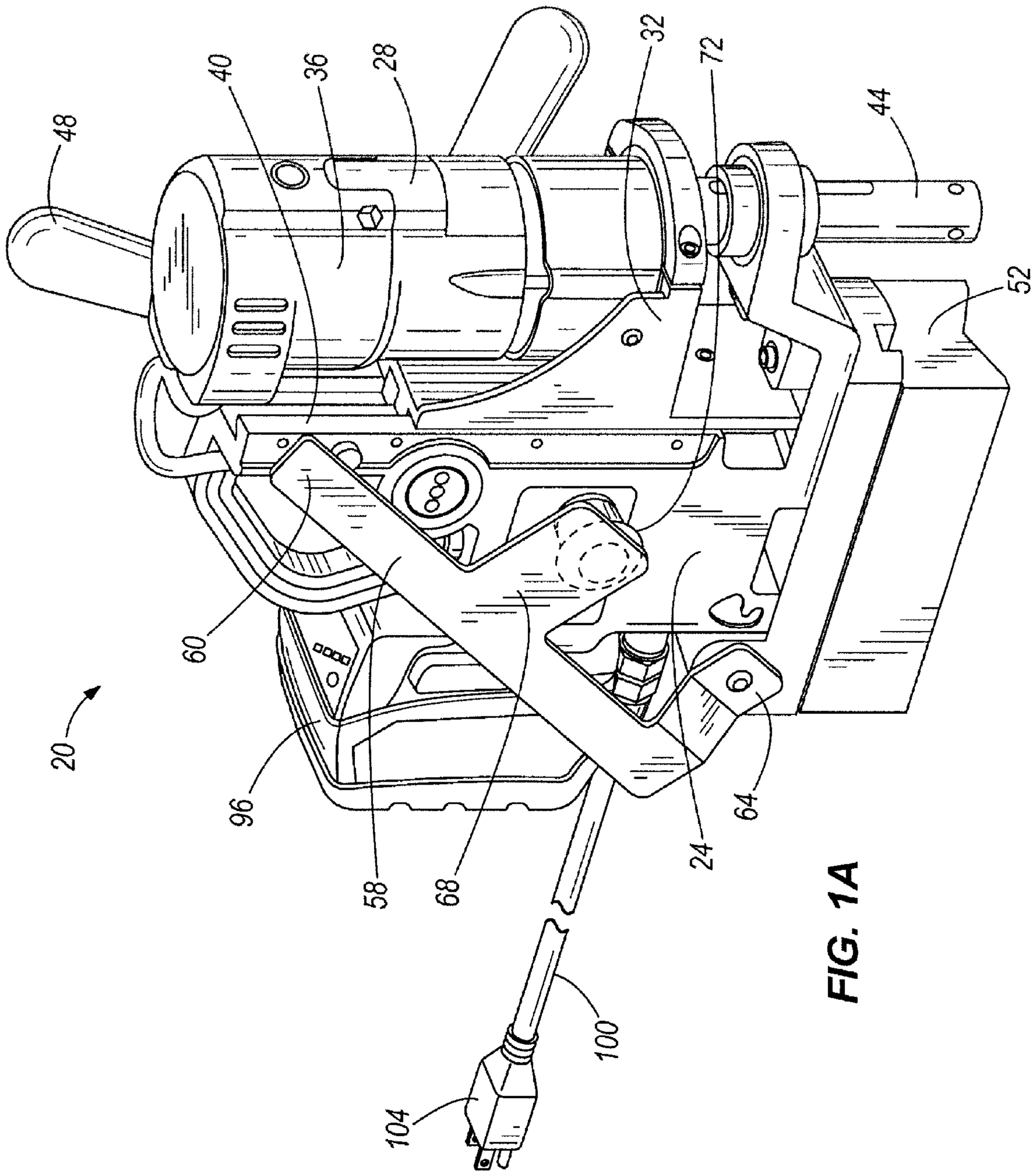


FIG. 1A

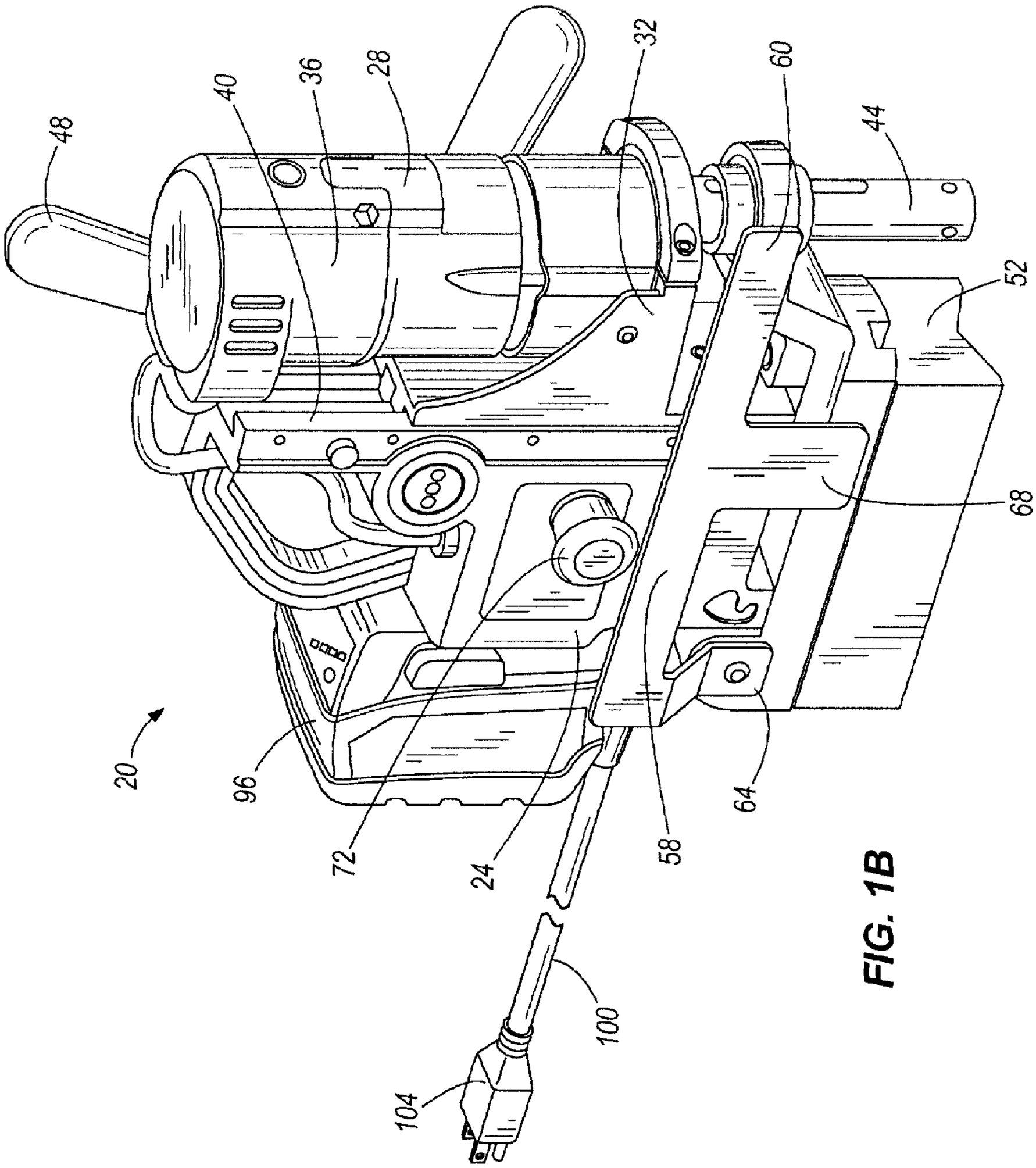


FIG. 1B

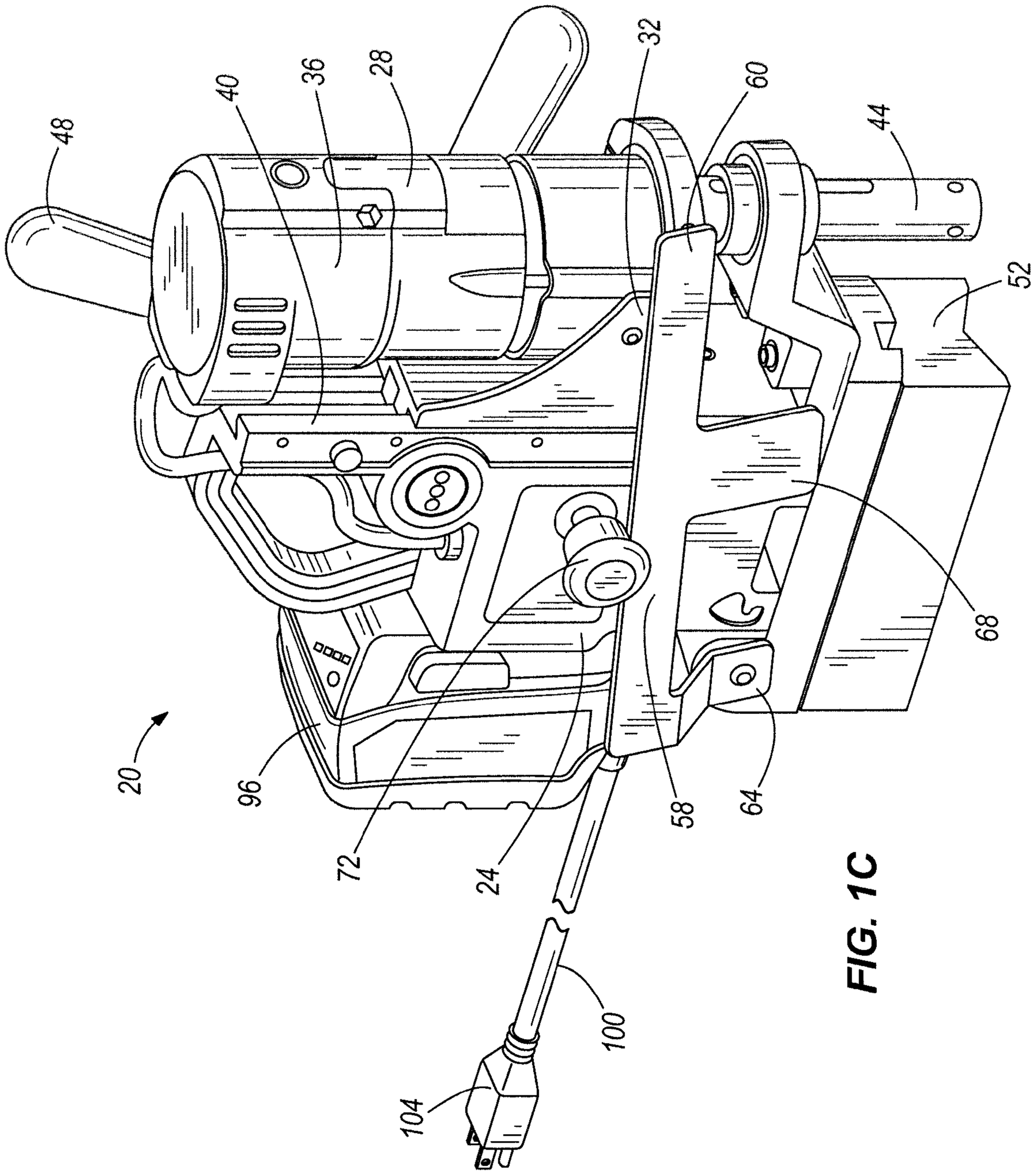
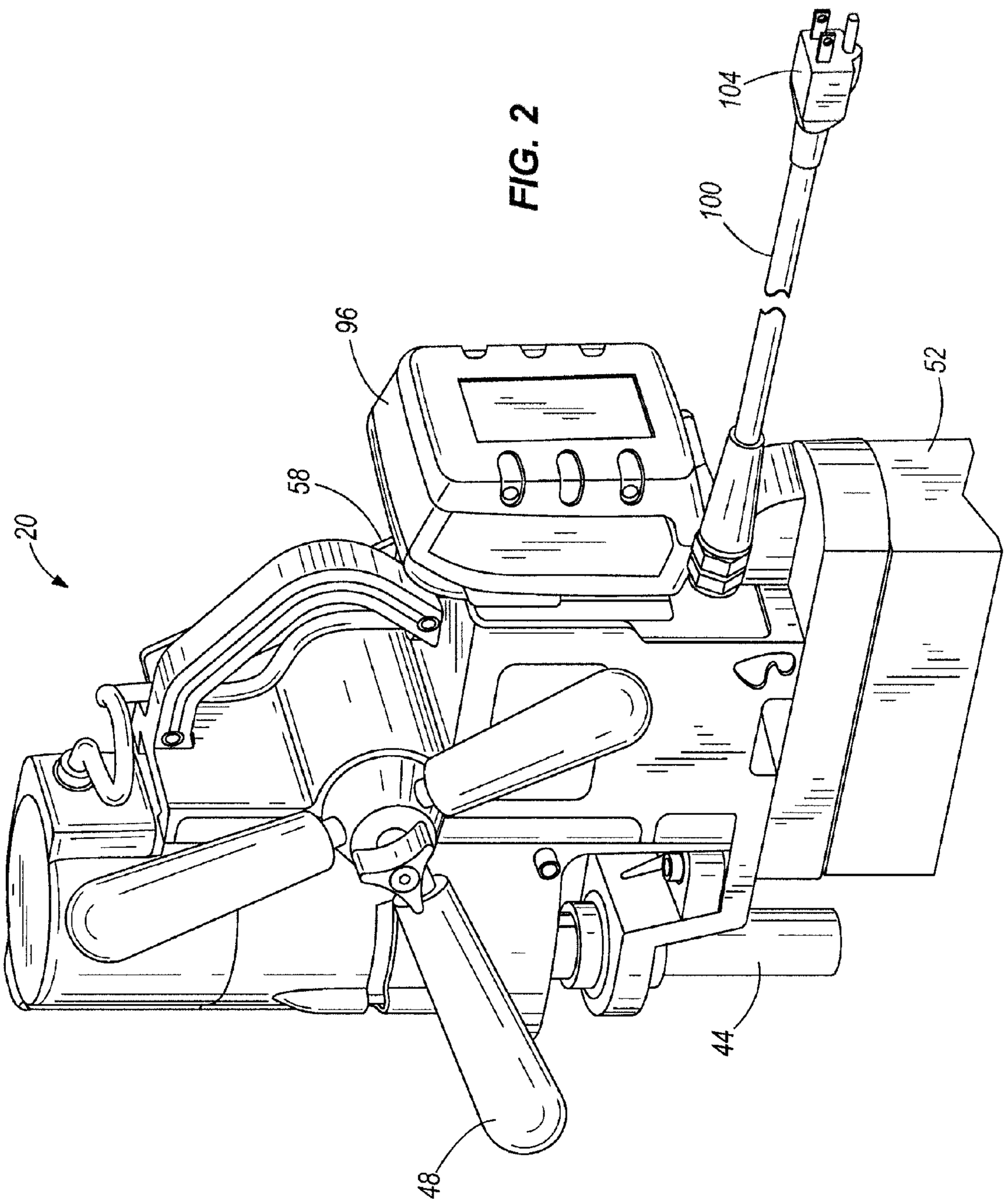


FIG. 1C

FIG. 2



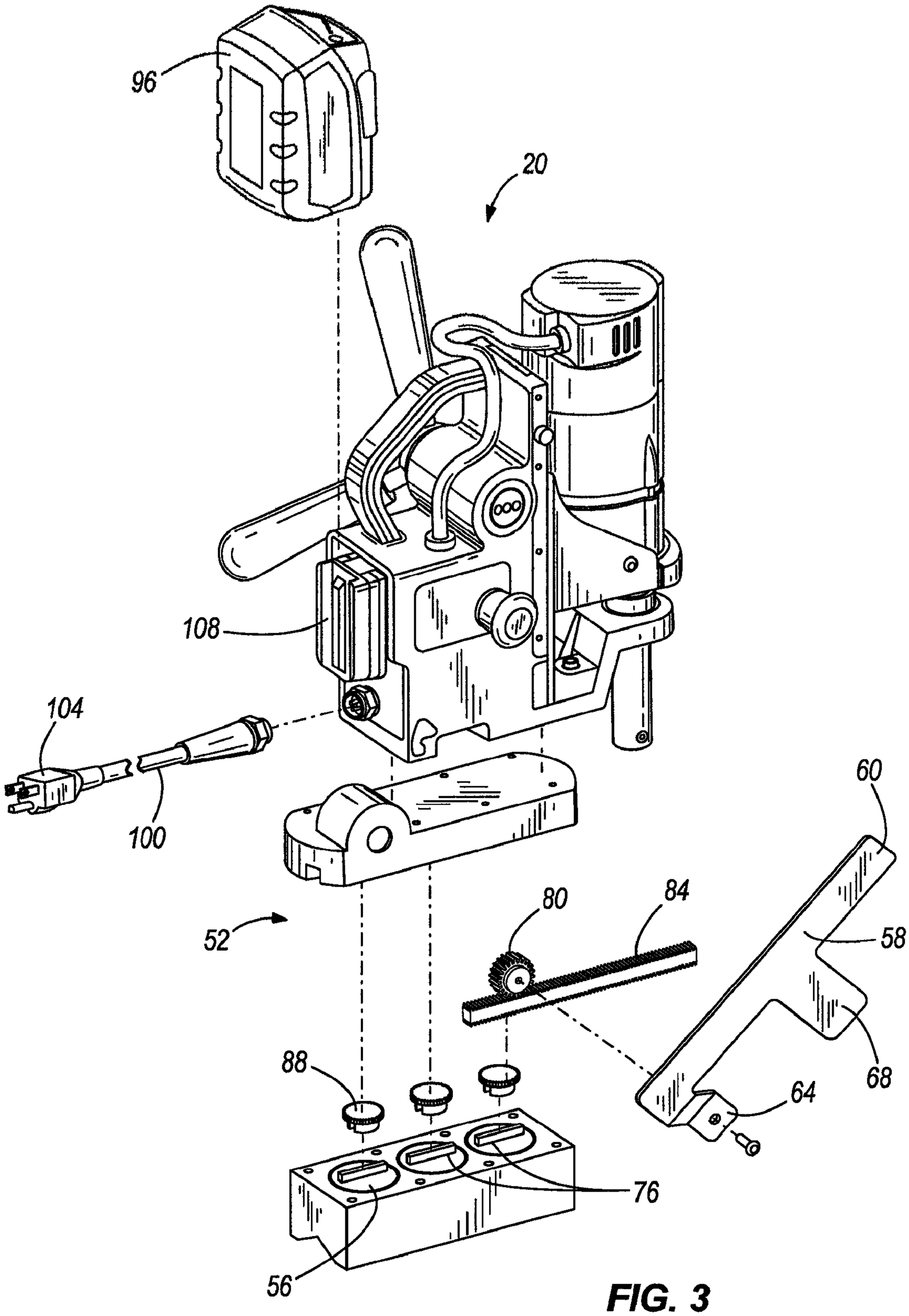


FIG. 3

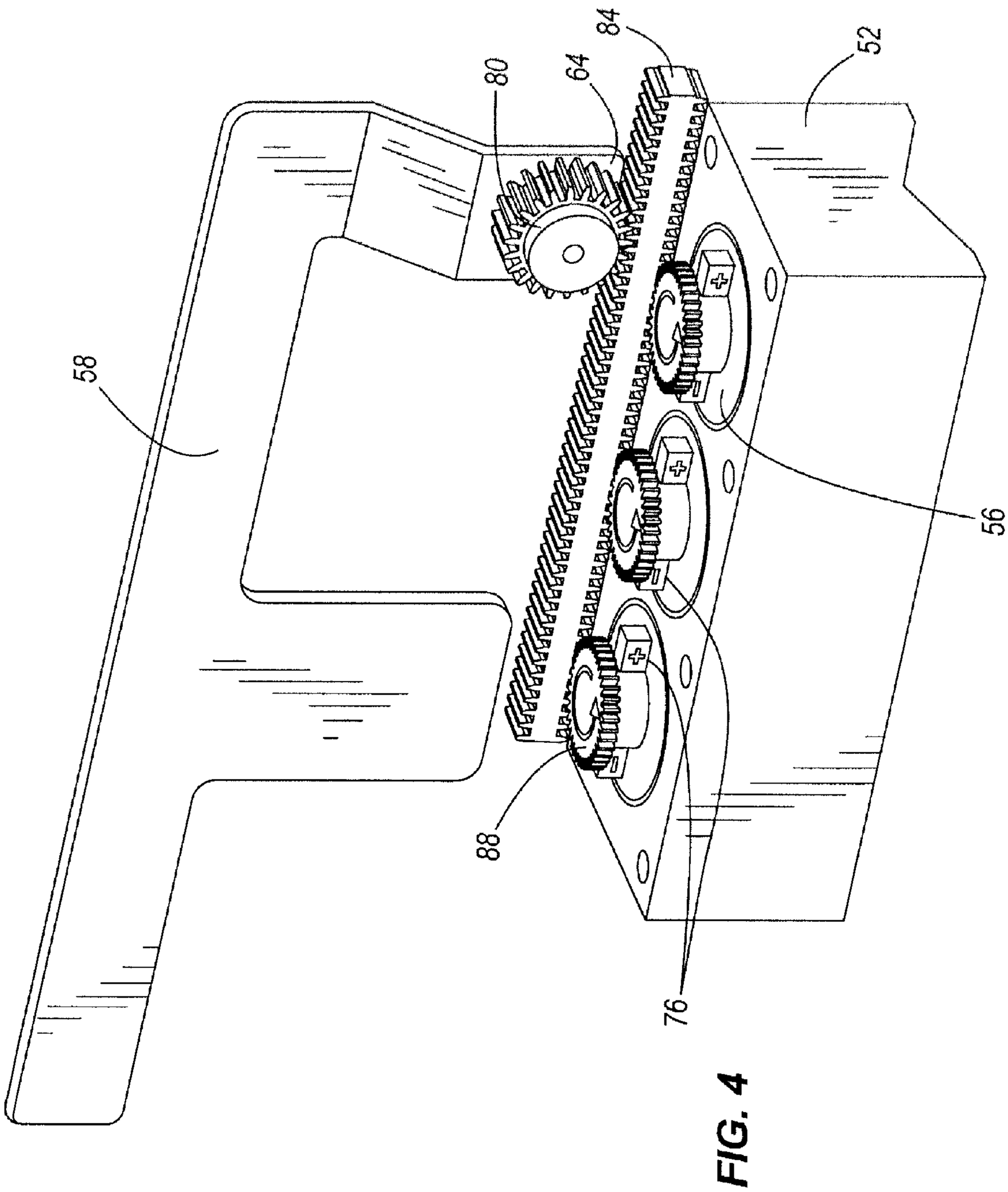


FIG. 4

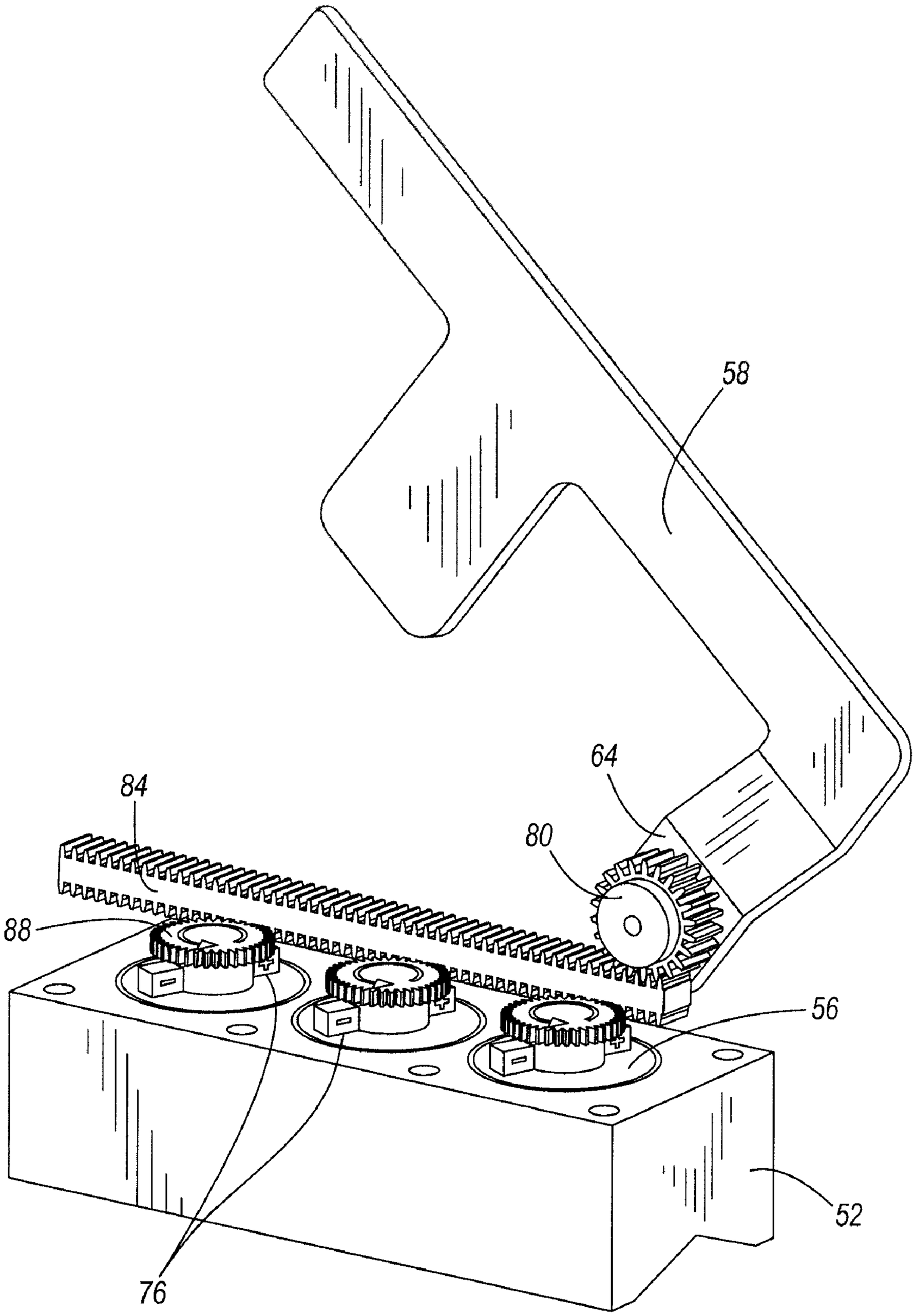


FIG. 5

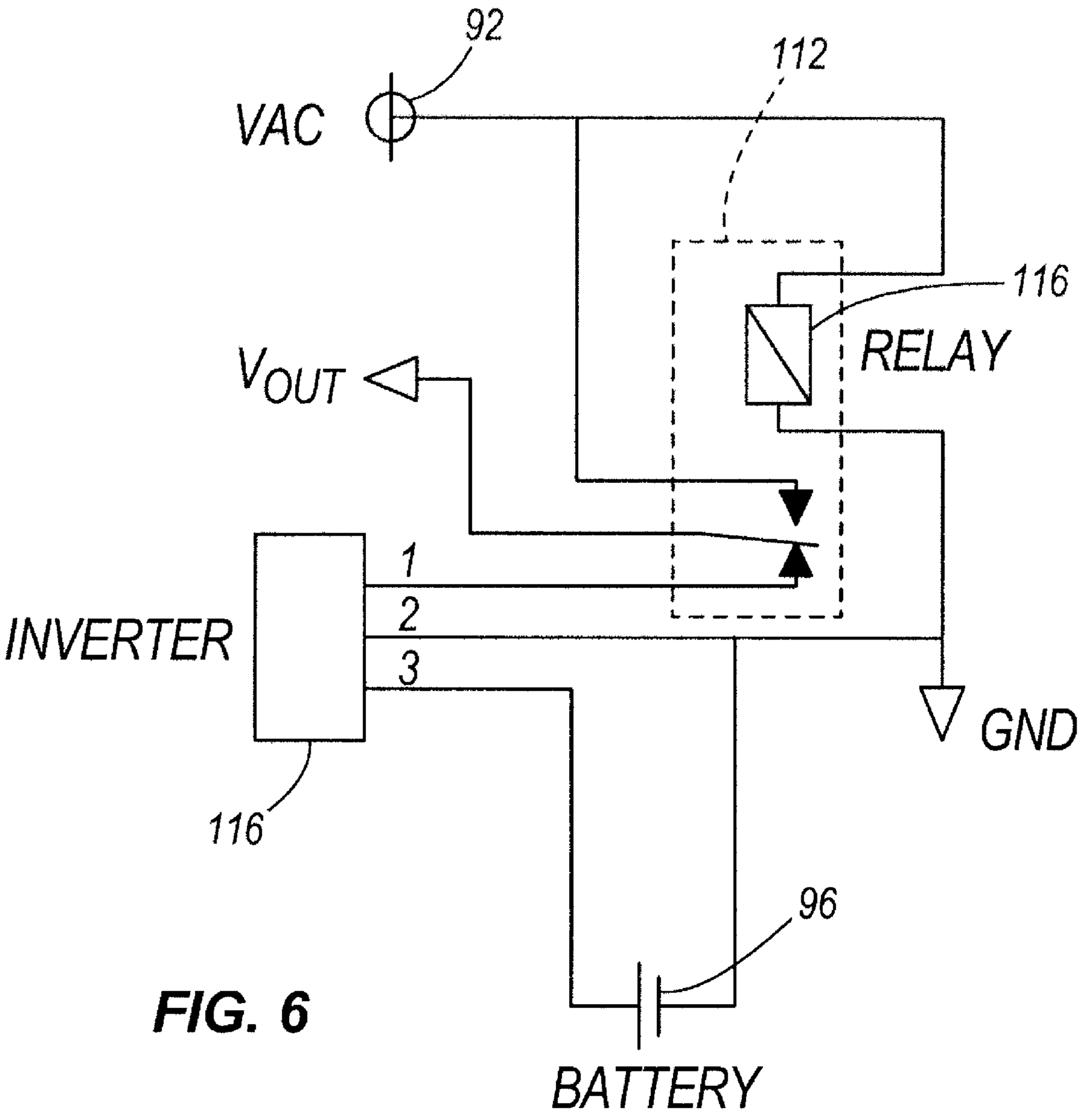


FIG. 6

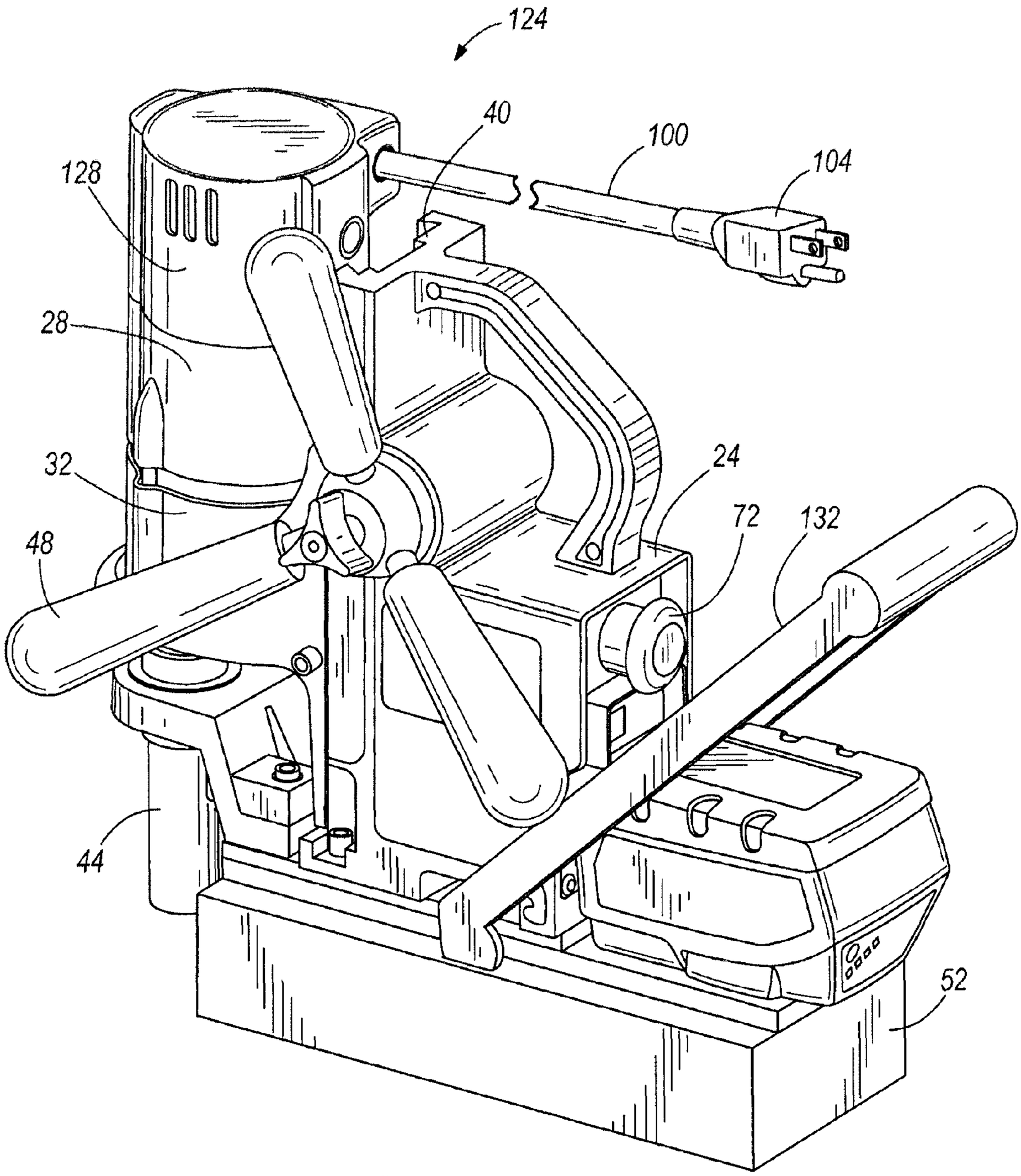


FIG. 7

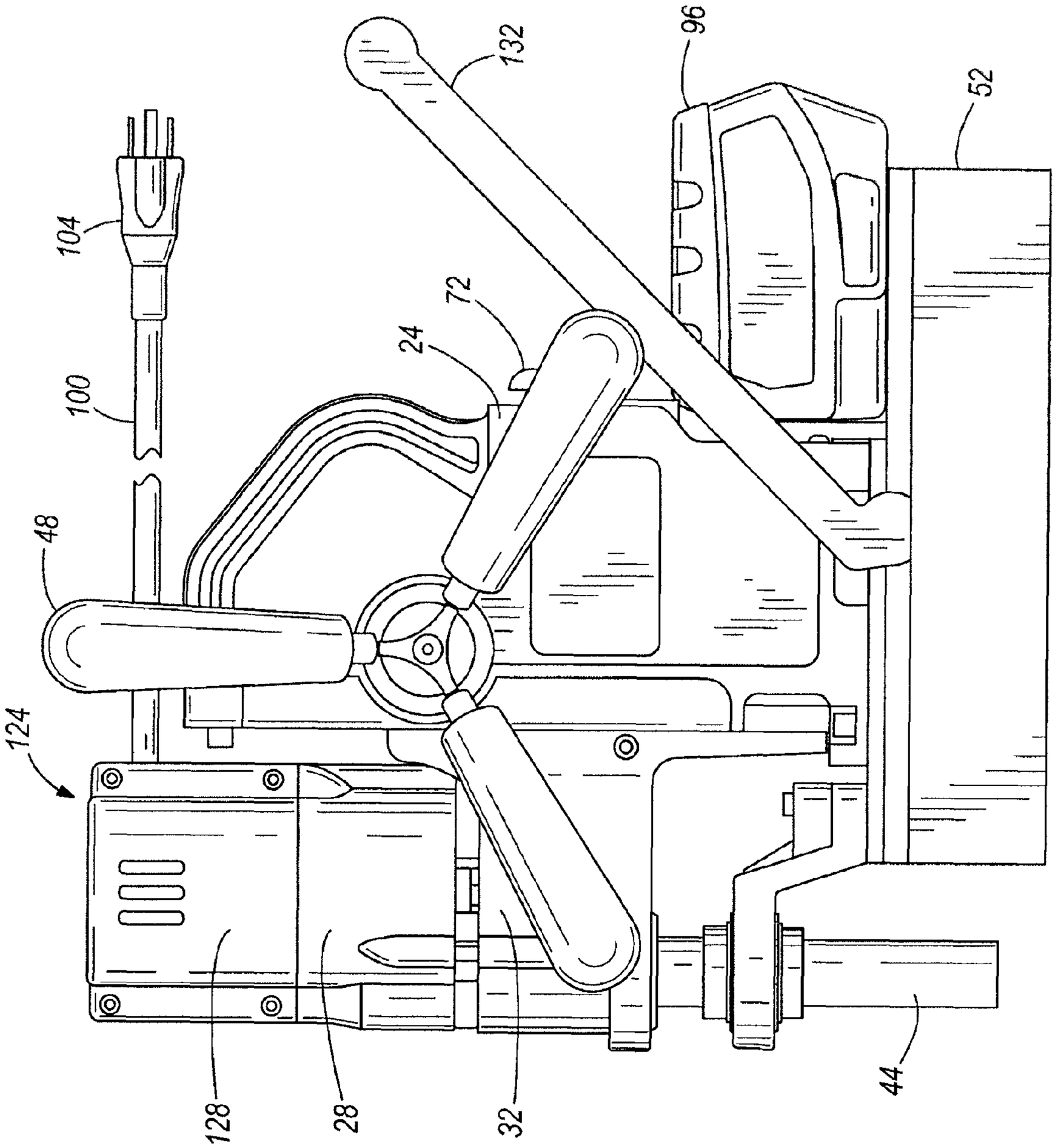


FIG. 8

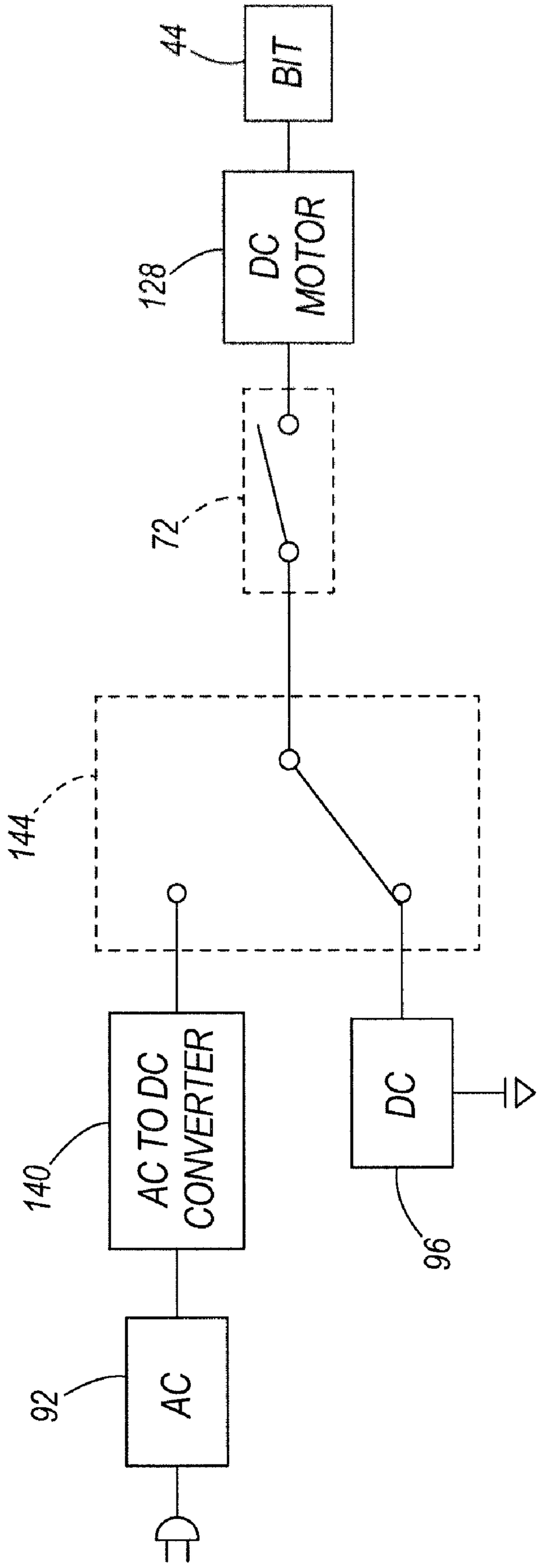


FIG. 9

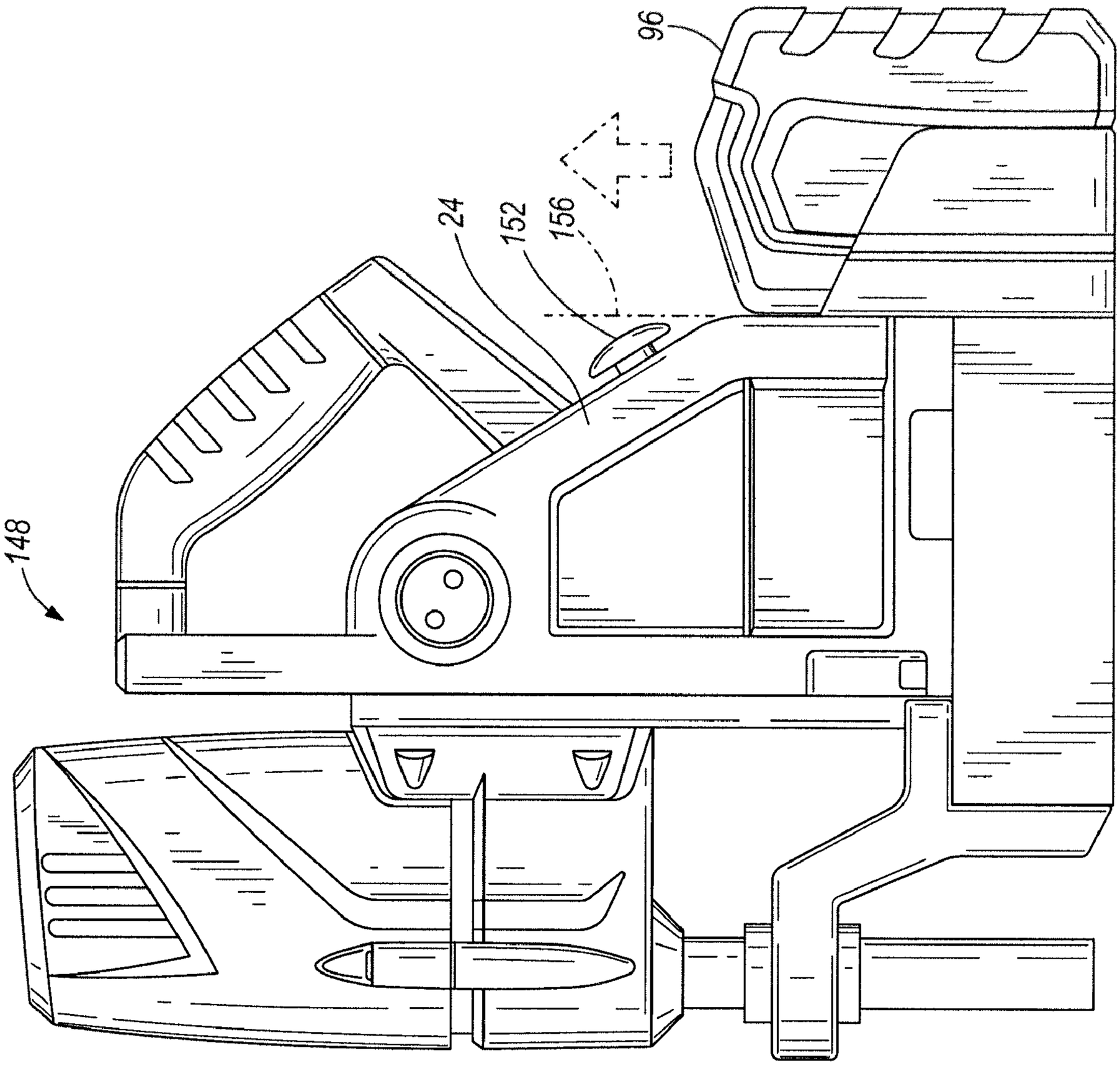


FIG. 10

AC/DC MAGNETIC DRILL PRESS

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to U.S. Provisional Application No. 60/952,367, entitled "AC/DC Magnetic Drill Press", filed Jul. 27, 2007 by Edward D. Wilbert, John S. Scott, and Jonathon A. Zick, the entire contents of which is hereby incorporated by reference.

BACKGROUND

The present invention generally relates to power tools and, more specifically, to magnetic-base drill presses.

Magnetic-base drill presses perform drilling operations by attaching a base portion of the drill press magnetically to a ferromagnetic workpiece. The magnetic base of a magnetic drill press is switchably operable between magnetized and demagnetized positions using electromagnets or permanent magnets. AC powered magnetic drill presses may be run non-stop, so long as they receive a constant source of AC electric power. However, AC powered magnetic drill presses lack utility under circumstances where AC power is unavailable.

SUMMARY

In one embodiment, the invention provides a power tool comprising a housing and a base coupled to a portion of the housing. The base is operable for magnetically coupling the tool to a workpiece. The power tool includes an electric motor supported by the housing, and a DC power source and an AC power input for providing power to the motor. A power supply switching unit, electrically coupled to the DC power source and the AC power input, selectively electrically couples the motor with one of the DC power source and the AC power input.

In another embodiment, the invention provides a drill press comprising a housing, and a motor assembly. The motor assembly includes an electric motor and drill bit. A motor carriage is attached to the housing, and the motor carriage is operable for moving the motor assembly relative to the housing. A base, coupled to a portion of the housing, is operable for magnetically coupling the tool to a workpiece. The drill press also includes a DC power source and an AC power input for providing power to the motor. A power supply switching unit, electrically coupled to the DC power source and the AC power input, selectively electrically couples the motor with one of the DC power source and the AC power input for providing power to the motor.

Other aspects of the invention will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is a perspective view of a magnetic drill press according to one embodiment of the invention, with the drill press shown in a demagnetized position.

FIG. **1**B is a detail view of the drill press shown in FIG. **1**A, and shown in a magnetized position.

FIG. **1**C is a detail view of the drill press shown in FIG. **1**A, and showing operation of a mechanical interlock between a magnetic base actuating lever and a power switch.

FIG. **2** is a rear perspective of the drill press shown in FIG. **1**A.

FIG. **3** is an exploded view of the drill press shown in FIG. **1**A.

FIG. **4** is an internal perspective view of a magnetic base of the drill press shown in FIG. **1**A, with the base shown in the magnetized position.

FIG. **5** is an internal perspective view of the magnetic base of the drill press shown in FIG. **1**A, with the base shown in the demagnetized position.

FIG. **6** is a circuit diagram illustrating a power switching module of the drill press shown in FIG. **1**A.

FIG. **7** is a perspective view of a magnetic drill press according to another embodiment of the invention.

FIG. **8** is a side view of the drill press shown in FIG. **7**.

FIG. **9** is a circuit diagram illustrating a power switching module of the drill press shown in FIG. **7**.

FIG. **10** is a side view of a drill press according to another embodiment of the invention, and shows a mechanical interlock between a battery pack and a power switch.

Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

DETAILED DESCRIPTION

FIGS. **1**A-**1**C and **2**-**3** illustrate a drill press **20** according to one embodiment of the invention. The drill press **20** includes a housing **24**, a motor housing **28** and a motor carriage **32**. An AC electric motor **36** is housed within the motor housing **28**. The motor housing **28** and the motor **36** are coupled to the motor carriage **32**, which moves vertically along a rack **40** that is in turn coupled to the housing **24**. The motor **36** is coupled to a bit **44** used to drill into a workpiece (not shown). A user works the bit **44** into the workpiece by moving the motor carriage **32** along the rack **40**. The user actuates a handle **48**, which engages with the rack **40** and then moves the motor carriage **32** in the desired direction (e.g., up or down along the rack **40**).

The drill press **20** further includes a magnetic base or stand **52** for magnetically detachably coupling the drill press **20** and a ferromagnetic workpiece. Once magnetized, the magnetic base **52** secures the press **20** to the workpiece via a magnetic field generated by magnets **56** (FIG. **3**). In the illustrated embodiment, the base **52** is actuated between a magnetized position (FIGS. **1**B-**1**C) and a demagnetized position (FIG. **1**A) by a lever **58**. The lever **58** includes a first end **60** defining a handle and a second end **64** pivotally coupled to the base **52**. The lever **58** further includes an interlock tab **68** positioned between the first and second ends **60**, **64**. The interlock tab **68** prevents use of the drill press **20** when the press **20** is decoupled from the workpiece. FIG. **1**A illustrates the lever **58** in the demagnetized position, and FIGS. **1**B and **1**C illustrate the lever **58** in the horizontal, magnetized position.

FIGS. **1**A-**1**C illustrate a mechanical interlock between a power (on/off) switch **72** of the drill press **20** and the magnetic base actuating lever **58**. The power switch **72** operates as a push/pull knob or button. With the power switch **72** in a fully in position (FIGS. **1**A and **1**B), the drill press **20** is "off" and the motor **36** is not powered. Likewise, with the switch **72** in a fully out position (FIG. **1**C), the drill press **20** is "on" and power is provided to the motor. Referring to FIG. **1**A, when the lever **58** is in a demagnetized position, whereby base **52** is

substantially demagnetized and decoupled from a workpiece, the interlock tab **68** of lever **58** prevents outward movement of the switch **72** (i.e., movement of the switch **72** to the on position). Thus, the interlock tab **68** prevents the user from operating the drill press **20** when the base **52** is demagnetized and not coupled to a workpiece.

In order to move the lever **58** to the magnetized position, thereby generating the magnetic field whereby the base **52** is secured to a workpiece, the switch **72** is in the off position. When the lever **58** is moved to the magnetized position, withdrawal of the power switch **72** to the on position is allowed. Referring to FIG. **1**C, the power switch **72** is dimensioned such that in the outward, on position, the switch **72** extends into a travel path of the lever **58**, thereby creating an interference between the power switch **72** and the lever **58**. The extended power switch **72** interferes with rotational travel of the lever **58** to prevent the user from demagnetizing the base **52**, and thereby decoupling the base from the workpiece, when the drill press **20** is on. In order to demagnetize the base **52**, the user must move the power switch to the off position before moving the lever **58** to the demagnetized position.

FIGS. **3-5** illustrates internal components of the magnetic base **52**, including permanent magnets **56** that create a strong magnetic field when opposite poles **76** of the magnets **56** are aligned. The base **52** secures the press **20** to the ferromagnetic workpiece (not shown) via the magnetic field generated by the aligned magnets **56**. The magnets **56** are movable between an aligned position (FIG. **4**), whereby opposite poles **76** of the magnets **56** are aligned to magnetize the base **52**, and an un-aligned position (FIG. **5**), whereby opposite poles **76** of the magnets **56** are not aligned and the base **52** is substantially demagnetized. In the illustrated embodiment, three magnets are used, but in further embodiments fewer or more magnets may be used.

The base **52** also includes a pinion gear **80** coupled to the second end **64** of the lever **58**, a gear-toothed rack **84**, and geared head portions **88**, each of the head portions **88** coupled to one of the magnets **56** such that each magnet **56** rotates with the respective head portion **88**. The pinion gear **80** intermeshes with one side of the rack **84**, and an opposite side of the rack **84** intermeshes with the head portions **88**.

With the lever **58** in the magnetized position (FIGS. **1**B and **4**), opposite (i.e., positive and negative) poles **76** of adjacent magnets **56** are aligned, thereby creating a magnetic field to secure the base **52** to the workpiece (not shown). Once drilling operations are complete and the power switch **72** has been placed in the off position, the user rotates the lever **58** to the demagnetized position. Rotating the lever **58** to the demagnetized position causes the pinion gear **80** to act upon the rack **84** and thereby rotate the head portions **88** of the magnets **56** approximately 90 degrees (FIGS. **1**A and **5**). In a further embodiment, the head portions **88** may rotate more or less than 90 degrees. The magnetic poles **76** of adjacent magnets **56** are rotated out of alignment, and the magnetic field created by base **52** is weakened to decouple the base **52** from the workpiece and allow repositioning of the drill press **20**.

As shown in FIGS. **1-3**, the drill press **20** may be powered by either an AC power source **92** (FIG. **6**) or a DC power source **96**. The press **20** includes an electrical cord **100** and plug **104** to connect to the AC power source **92**. The AC power source **92** may be a conventional 120V or 240V power source. In the illustrated embodiments, the electrical cord **100** and plug **104** may be of a quick detachable type, such as the QUIK-LOK® cord of Milwaukee Electric Tool Corporation (Brookfield, Wis.) or the detachable power cord disclosed by U.S. Pat. No. 6,609,924, entitled "Quick Lock Power Cord", the entire contents of which is hereby incorporated by reference. A detachable power cord allows for cords of various lengths to be used, and easy and quick replacement of cords that are cut, frayed, or otherwise damaged.

Referring to FIG. **3**, the drill press **20** also includes a battery pack connector block **108** to connect the DC power source **96**. In the illustrated embodiment, the DC power source **96** is a removeable, rechargeable battery pack that electrically couples to the motor **36** such that the drill press **20** can operate as a portable, battery-operated power tool. The illustrated battery pack **96** is a 28-volt power tool battery pack including seven (7) Lithium-ion battery cells and slidingly coupled to the drill press **20** via the connector block **108**. In other embodiments, the battery pack **96** may include fewer or more battery cells such that the battery pack is a 14.4-volt power tool battery pack, a 32-volt power tool battery pack, or the like. Additionally or alternatively, the battery cells may have chemistries other than Lithium-ion such as, for example, Nickel Cadmium, Nickel Metal-Hydride, or the like.

FIG. **6** illustrates a power switching module **112** coupled to both the DC power source **96** and the AC power source **92**. In this construction, an inverter **116** converts voltage of the DC power source **96** to a suitable AC voltage for the motor **36**. Downstream of the inverter **116**, a relay **120** allows for switching between the two power sources. In the illustrated embodiment, the module **112** includes a relay circuit that would be normally closed on the DC power source **96** (via the inverter **116**) and open on the AC power source **92**. In such a case the module **112** would default to the DC power source **96** in the absence of the AC power source **92** (e.g., when the electrical cord **100** is not plugged into the AC power source **92** or no power is available to the AC power source **92**). If both power sources are available, the relay would connect the AC power source **92** to the motor **36**. In further embodiments, other known relay and switch arrangements may be used between the two power sources and the motor, for example, a manual switch may be used to allow the user to selectively switch between the power sources.

FIGS. **7** and **8** illustrate a drill press **124** according to another embodiment of the invention. The drill press **124** is similar to the drill press **20** shown in FIGS. **1**A-**1**C and **2-5**; therefore, like structure will be identified by the same reference numerals. The drill press **120** includes the housing **24**, the motor housing **28** and the motor carriage **32**. A DC electric motor **128** is housed within the motor housing **28**. The motor housing **28** is connected to the motor carriage **32**, which is vertically movable along the rack **40** coupled to the housing **24**. The motor **128** is coupled to the bit **44** used to drill into a workpiece (not shown). A user works the bit **44** into the workpiece by moving the motor carriage **32** along the rack **40**. The user actuates the handle **48**, which engages with the rack **40** and then moves the motor carriage **32** in the desired direction.

The drill press **124** further includes the magnetic base **52**. Once magnetized, the magnetic base **52** secures the press **124** to the ferromagnetic workpiece via the magnetic field generated by internal magnets. In the embodiment shown in FIGS. **7** and **8**, base **52** is actuated between magnetized and demagnetized positions by a lever **132**. The internal operations of the base **52** are similar to that described in the previous embodiment.

FIG. **9** schematically illustrates a power circuit used to supply electrical power to the DC motor **128** of the drill press **124**. The drill press **124** includes an AC to DC converter **140**. The converter **140** couples to the AC power source **92** and converts the input AC power to the appropriate DC power signal for the motor **128**.

A power switching module **144** is coupled to both the converter **140** and the DC power source **96**. The switching module **144** controls which power source is coupled to the motor **128** via power switch **72**. In some constructions, the switch module **144** can be a mechanical switch that the user has to select manually or can be activated by connecting or removing the DC power source **96**. In other constructions, the switching module **144** is automatic. In one construction, for example, the module **144** can sense when the drill **120** is connected to the AC power source **92** and switches accordingly. In this construction, for example, when the module **144** senses that the drill **124** is not connected to the AC power source **92**, the module **144** switches to the DC power source **96**.

FIG. **10** illustrates a drill press **148** according to another embodiment of the invention. The drill press **148** is similar to the drill press **20** shown in FIGS. **1**A-**1**C and **2**-**5**; therefore, like structure will be identified by the same reference numerals. Other features of this embodiment not described or identified correspond to the common features discussed in the previous embodiments. The drill press **148** includes a power switch **152** located on a rear portion of the tool housing assembly **24** and above the battery pack connector block **108**. The switch **152** operates as a push/pull type, as described with respect to FIGS. **1**A-**1**C and **2**-**3**. A forward surface of the battery pack **96**, when mounted in the connector block **108**, defines a vertical plane **156**. By placing the switch **152** proximate the battery pack **96**, the user is forced to push the switch in (i.e., the off position) before removing or attaching the battery pack **96**. The on position of the switch **152** creates an interference through vertical plane **156** between the switch **152** and the battery pack **96**, thereby preventing removal or insertion of the battery pack **96** when the switch **152** is in the on position.

Although the invention has been described with reference to certain preferred embodiments, variations and modifications exist within the scope and spirit of one or more independent aspects of the invention as described. Accordingly, the invention is not to be restricted except in light of the attached claims and their equivalents.

What is claimed is:

1. A power tool comprising:
a housing;
a base coupled to a portion of the housing, the base operable for magnetically coupling the tool to a workpiece;
an electric motor supported by the housing;
a DC power source for providing power to the motor;
an AC power input for providing power to the motor, the AC power input configured for receiving power from an AC power source;
a power supply switching unit electrically coupled to the DC power source and the AC power input, the switching unit selectively electrically coupling the motor with one of the DC power source and the AC power input, wherein the switching unit includes a relay operable to switch to one of the DC power source and the AC power input upon loss of power from the other of the DC power source and the AC power input; and
a power switch for providing power to the motor from one of the DC power source and the AC power input via the switching unit, wherein the DC power source includes a battery removably coupled to the housing by insertion along a plane, the plane interferingly crossing the power switch when the power switch is in an on position to thereby form an interlock between the battery and the power switch.

2. The power tool of claim **1** wherein the base includes a magnet.

3. The power tool of claim **2** wherein the magnet is movable between a magnetized position for coupling the tool to the workpiece and a demagnetized position.

4. The power tool of claim **3**, and further comprising an actuator for moving the magnet between the magnetized position and the demagnetized position.

5. The power tool of claim **3** wherein the magnet comprises a plurality of magnets, and further wherein when the magnets are in the magnetized position opposite poles of adjacent magnets are aligned and when the magnets are in the demagnetized position opposite poles of adjacent magnets are out of alignment.

6. The power tool of claim **1** wherein the base includes an actuator for selectively coupling the tool to the workpiece, and further wherein the power switch prevents the actuator from decoupling the tool to the workpiece when the power switch is in an on position.

7. The power tool of claim **6** wherein the actuator prevents the power switch from being placed in the on position when the tool is decoupled from the workpiece.

8. The power tool of claim **1** wherein the battery is a lithium-ion based battery pack.

9. The power tool of claim **1** wherein the AC power input receives a power cord.

10. The power tool of claim **1**, wherein the switching unit preferentially supplies power from the AC power input to the motor.

11. A drill press comprising:
a housing;
a motor assembly including an electric motor and drill bit;
a motor carriage attached to the housing operable for moving the motor assembly relative to the housing;
a base coupled to a portion of the housing, the base operable for magnetically coupling the drill press to a workpiece;
a DC power source for providing power to the motor;
an AC power input for providing power to the motor, the AC power input configured for receiving power from an AC power source;
a power supply switching unit electrically coupled to the DC power source and the AC power input, the switching unit selectively electrically coupling the motor with one of the DC power source and the AC power input for providing power to the motor; and
a power switch for providing power to the motor from one of the DC power source and the AC power input via the switching unit, wherein the DC power source includes a battery removably coupled to the housing by insertion along a plane, the plane interferingly crossing the power switch when the power switch is in an on position to thereby form an interlock between the battery and the power switch.

12. The drill press of claim **11**, wherein the base includes a magnet.

13. The drill press of claim **12**, wherein the magnet is movable between a magnetized position for the coupling the drill press to the workpiece and a demagnetized position.

14. The drill press of claim **13**, and further comprising an actuator for moving the magnet between the magnetized and demagnetized position.

15. The drill press of claim **13**, wherein the permanent magnet comprises a plurality of magnets, further wherein when the magnets are in the magnetized position opposite

poles of adjacent magnets are aligned and when the magnets are in the demagnetized position opposite poles of adjacent magnets are out of alignment.

16. The drill press of claim **11** wherein the base includes an actuator for selectively coupling the drill press to the workpiece, and further wherein the power switch prevents the actuator from decoupling the drill press to the workpiece when the power switch is in an on position.

17. The drill press of claim **16** wherein the actuator prevents the power switch from being placed in the on position when the drill press is decoupled from the workpiece.

18. The drill press of claim **11**, wherein the power supply switching unit includes a relay operable to switch to one of the DC power source and the AC power input upon the loss of another of the DC power source and the AC power input.

19. The drill press of claim **18**, wherein the power supply switching unit preferentially supplies power from the AC power input when available.

20. The drill press of claim **18**, wherein the power supply switching unit preferentially supplies power from the DC power source when available.

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